REMARKS

Reconsideration and withdrawal of the rejections of this application and consideration and entry of this paper are respectfully requested in view of the amendments and remarks herein, which place the application in condition for allowance.

I. STATUS OF CLAIMS AND FORMAL MATTERS

Claims 1-16 and 21-29 are pending. Claims 5, 22, 24, 26, 28 and 29 are amended, and claims 17-20 are cancelled, without prejudice, without admission, without surrender of subject matter, and without any intention of creating any estoppel as to equivalents.

No new matter is added.

It is submitted that the original claims and as presented herewith are patentably distinct from the references cited by the Examiner, and that these claims are and were in full compliance with the requirements of 35 U.S.C. §112. The amendments to the claims herein are not made for the purpose of patentability within the meaning of 35 U.S.C. §§ 101, 102, 103 or 112; but rather the amendments are made simply for clarification and to round out the scope of protection to which Applicant is entitled. Support for the amended claims may be found in the specification on page 12, line 4.

II. ARRANGEMENT OF THE SPECIFICATION

The Examiner is thanked for his suggestions regarding the arrangement of the specification. However, Applicants have decided to forgo any changes to the specification at this time.

III. OBJECTION TO THE CLAIMS

Claim 5 has been objected to under 37 C.F>R. §1.75(c) as allegedly being of improper dependent form for failing to further limit the subject matter of a previous claim. The objection is respectfully traversed.

The Office Action has asserted that while claim 1 refers to an enzyme "obtained or obtainable" from a marine organism, i.e. an enzyme in its native state, claim 5 contains the phrase "or a variant, homologue, derivative or fragment thereof" which expands the scope of

claims 4 and 5 to include mutants and other carbohydrate oxidizing enzymes from any biological source as well as chemically modified enzymes.

We disagree with the Office Action's interpretation of claim 5. Claim 1 refers to an enzyme obtained or obtainable from a marine organism; claim 4 refers to a hexose oxidase enzyme obtained or obtainable from a marine organism; and claim 5 refers to a hexose oxidase enzyme obtained or obtainable from a marine organism, wherein the hexose oxidase enzyme comprises either the amino acid sequence set out in SEQ 11 ID No. 1, or a variant, homologue, derivative or fragment of that amino acid sequence which has at least 75% homology with SEQ 11 ID No. 1. Thus claim 4 limits the scope of claim 1 by requiring that the enzyme be a hexose oxidase enzyme but is not limited as to the amino acid sequence of that hexose oxidase enzyme. Claim 5 limits the scope of claim 4 by requiring that the hexose oxidase enzyme comprises either the amino acid sequence set out in SEQ. ID. No. 1 or a variant, homologue, derivative or fragment of that amino acid sequence. Thus the feature of claim 4 represents a limitation to the scope of claim 1 and, similarly, the feature of claim 5 represents a limitation to the scope of claim 4. Therefore we submit that claim 5 is in the proper dependent form since it refers to an enzyme having all the features of claim 4 and all the features of claim 1. Accordingly, reconsideration and withdrawal of the objection to claim 5 is respectfully requsted.

Additionally, the Office Action objected to claims 24 and 28 on the grounds that they are allegedly substantial duplicates of claims 22 and 26, respectively. The objection is respectfully traversed.

Claims 24 and 28 each refer to an enzyme obtained or obtainable from *Chondrus crispus*. In contrast, claims 22 and 26 refer to an enzyme obtained or obtainable from a marine organism. There is a substantial difference in scope between a marine organism in general and a specific species of marine alga. Therefore we submit that claims 24 and 28 are of substantially different scopes than claims 22 and 26 respectively and are not duplicates. Accordingly, reconsideration and withdrawal of the objections to claims 24 and 28 is respectfully requested.

IV. THE REJECTIONS UNDER 35 USC §112, 1st PARAGRAPH, ARE OVERCOME

Claims 1-16, 21, 23, 25 and 27 were rejected under 35 U.S.C. §112, first paragraph, as allegedly containing subject matter which was not described in the specification in such a way as

to reasonably convey to one skilled in the relevant art that the inventors had possession of the application at the time of filing. The rejection is respectfully traversed.

The Office Action alleges that the claims are directed to an anti-fouling composition comprising an enzyme obtained or obtainable from a marine organism, but that the specification provides only a single representative species: hexose oxidase from *Chondrus cripus*. Further, the Office Action alleges that the specification fails to describe additional representative species of these enzymes by an identifying structural characteristic or property.

The specification provides teaching on a variety of suitable enzymes other than hexose oxidase on page 7, lines 3 to 8, where the enzyme is described as an oxidase and preferable oxidases include "glucose oxidase, L amino acid oxidase, D amino oxidase, galactose oxidase, hexose oxidase, pyranose oxidase, malate oxidase, cholesterol oxidase, arylalcohol oxidase, alcohol oxidase, lathosterol oxidase, aspartate oxidase, amino oxidase, D glutamate oxidase, ethanolamine oxidase, NADH oxidase, urate oxidase" and mixtures thereof.

Further, the specification provides that the enzyme substrate combination may be "glucose/hexose oxidase, glucose/glucose oxidase, L amino acid/L amino acid oxidase, galactose/galactose oxidase, lactose b-galactosidase/hexose oxidase, lactose/b-galactosidase/glucose oxidase, 2-deoxyglucose/glucose oxidase, pyranose/pyranose oxidase, and mixtures thereof," on page 15, lines 4 to 8.

Furthermore, the assay described in Example 1 is intended to be of general applicability. It is stated in Example 1 that "[t]o ascertain its suitability for use in the present invention the activity of the enzyme may be assayed as follows" (page 22, lines 1-2). Thus, one of skill in the art is taught how to judge whether a particular enzyme from a marine organism is capable of being used in the present invention without undue experimentation.

Accordingly, it is clear that Applicants were in possession of the present invention at the time of filing. Consequently, reconsideration and withdrawal of the rejection under 35 U.S.C. §112, first paragraph is respectfully requested.

Claims 1 to 16, 21, 23, 25 and 27 have also been rejected under 35 U.S.C. §112, first paragraph as the disclosure is allegedly enabling only for claims limited to an anti-fouling composition comprising *Chondrus crispus* hexose oxidase of SEQ ID No. 1 and any of its known substrates listed in the specification. The rejection is respectfully traversed.

The Office Action states that one of skill in the art would not be able to make and use the

present invention without additional guidance not present in the specification. Applicants disagree.

It is respectfully submitted that the assertion in the Office Action that undue experimentation is required to practice the instantly claimed invention is inaccurate. The Examiner is respectfully directed to *In re Wands*, 8 U.S.P.Q. 2d 1400 (Fed. Cir. 1988), wherein the Federal Circuit stated at 1404 that:

> Enablement is not precluded by the necessity for some experimentation such as routine screening. However, experimentation needed to practice the invention must not be undue experimentation. 'The key word is undue, not experimentation.' The determination of what constitutes undue experimentation in a given case requires the application of standard of reasonableness, having due regard for the nature of the invention and the state of the art. The test is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine, or if the specification in question provides a reasonable amount of guidance with respect to the direction in which the experimentation should proceed ... [Citations omitted].

Against this background, determining whether undue experimentation is required to practice a claimed invention turns on weighing the factors summarized in *In re Wands*. These factors include, for example, (1) the quantity of experimentation necessary; (2) the amount of direction or guidance presented; (3) the presence or absence of working examples of the invention; (4) the nature of the invention; (5) the state of the prior art; (6) the relative skill of those in the art; (7) the predictability or unpredictability of the art; and (8) the breadth of the claims; all of which must be taken into account.

Applying the law to the instant facts, it is clear that enablement exists. To this end, it is respectfully submitted that the specification provides one of ordinary skill in the art with sufficient guidance to make and use the present invention; see, for example, the specification at page 7, lines 3 to 8, page 15, lines 4 to 8, and page 22, lines 1-2.

The Office Action acknowledged that the Examples of the present application teach the

formulation of the enzyme hexose oxidase and its substrate into an anti-fouling composition and provide experimental evidence that the composition provides the desired results. The Examples also include an assay for measuring the activity of an enzyme by measuring the hydrogen peroxide generated (Example 1). Applicants respectfully submit that the Examples in the specification are intended to describe the invention by way of example *only* (page 20, line 31 to page 21, line 1) and are not intended tolimit the scope of the invention. The description, when read as a whole, provides enough teaching to enable one of ordinary skill in the art to make and use the invention commensurate with the scope of the claims. In particular, the description provides one of ordinary skill in the art with teaching on how to generalize the Examples without undue experimentation.

Additionally, the description provides teaching on a variety of suitable enzymes other than hexose oxidase on page 7, lines 3 to 8 and on page 15, lines 4 to 8 of the description. Furthermore, the assay described in Example 1 is intended to be of general applicability. It is stated in Example 1 that "[t]o ascertain its suitability for use in the present invention the activity of the enzyme may be assayed as follows" (page 22, lines 1-2). Thus, one of ordinary skill in the art is taught how to judge whether a particular enzyme from a marine organism is capable of solving the technical problem, without under experimentation.

The Office Action has also acknowledged that protein purification methods and molecular biological techniques as well as genetic manipulation to purify and make any enzyme from any biological source are known in the prior art and that the skill of the artisan is well developed. However, the Office Action has asserted that knowledge regarding (i) the desired enzymatic activities, (ii) their biological source and (iii) a method of redesigning the polypeptide of SEQ ID No. 1 by insertion, deletion, substitution and combination thereof of more than one amino acid residue is lacking.

It is respectfully submitted that the assay Example 1 would provide one of ordinary skill in the art with sufficient guidance regarding the desired enzymatic activities of an enzyme. Regarding the biological source of the enzyme, the specification states that the marine organism is obtained or obtainable from a marine organism and gives further guidance by stating that the marine organism is preferably a marine alga and more preferably *Chondrus crispus* (page 6, lines 24 to 29). Guidance is also given on page 8 to page 14 on how to produce a hexose oxidase

enzyme comprising the amino acid sequence set out in SEQ ID No. 1 or a variant, homologue, derivative or fragment thereof having at least 75% homology with SEQ ID No. 1.

Accordingly, it is respectfully submitted that the quantity of experimentation necessary is low; the amount of direction or guidance presented is high; the present application has adequate working examples of the invention; and the relative skill of those in the art is high.

Therefore, it is respectfully submitted that given the guidance provided by the specification and the well-developed skill of the artisan, the production of hexose oxidase enzymes comprising the amino acid sequence set out in SEQ ID No. 1 or a variant, homologue, derivative or fragment thereof having at least 75% homology with SEQ ID No. 1 would be routine and would not require any undue experimentation.

Reconsideration and withdrawal of the rejection under 35 U.S.C. §112, first paragraph is respectfully requested.

Furthermore, the Office Action rejected c1aims 1 to 29 under 35 U.S.C. §112, second paragraph, as allegedly being indefinite. The rejection is respectfully traversed.

Specifically, the Office Action stated that the phrase "precursor enzyme" in claims 1, 8, 9 and 16 is indefinite and should be distinguished from the "enzyme" in the claims. It is respectfully submitted that the understanding evinced by the Office Action that the precursor enzyme acts on the precursor substrate to generate a substrate for the "enzyme" is correct. Further, just as this nuance was recognized by the Office, it is verily believed that the terms "precursor enzyme" and "enzyme" would not be confused by one of skill in the art since it is clear from the claims and the description that they are distinct. Applicants also respectfully submit that the correct interpretation of "precursor enzyme adopted by the Office would also be adopted by one of ordinary skill in the art.

Furthermore, the Office Action stated that the phrase "obtained or obtainable" in claims 1-3, 16 and 21-28 was indefinite and for examination purposes was assumed to mean "known or unknown".

The claims of the present application relate to an enzyme obtained or obtainable from a marine organism. Any given enzyme may be isolated from a variety of sources and may differ considerably in properties, depending on the source. The present Applicants have identified that the use of an enzyme obtained or obtainable from a marine organism provides numerous advantages over the prior art, as discussed on pages 5 and 6 of the description. It is well known

in the art that enzymes arc commonly produced on a commercial scales synthetically or recombinantly. Limitation of the present application to enzymes obtained from a marine organism would represent an unfair limitation on the scope of protection, since many commercially important means of exploiting the invention would not be protected. The requirement in the claims that the enzyme is obtainable from a marine organism limits the claim to enzymes that are capable of being obtained from marine organisms, i.e. enzymes which could have been obtained from marine organisms, but which have in fact been produced in a different way. As such, the term "obtainable" does clearly set forth the metes and bounds of the patent protection sought. Enzymes which arc obtainable from a marine organism would have the same properties as enzymes obtained from marine organisms and it is these properties that the applicants have found to be advantageous. Applicants therefore submit that the requirement that the enzyme is obtainable from a marine organism is an important feature o the claim and is clear.

Additionally, the Office Action alleged that the phrase "or a variant, homologue, derivative or fragment thereof" in claim 5 renders the claims indefinite and, for examination purposes, was taken to mean any carbohydrate oxidase from any biological source, its mutants and fragments.

The phrase has been amended to "or a variant, homologue, derivative or fragment thereof having at least 75% homology with SEQ ID No. 1". The requirement of at least 75% homology represents a limitation to the scope of the claim that should serve to more clearly define the metes and bounds of the claim. Amended claim 5 refers to hexose oxidase enzyme comprising the amino acid sequence set out in SEQ ID No. 1 or a hexose oxidase enzyme comprising a variant, homologue, derivative or fragment of that amino acid sequence having at least 75% homology with SEQ ID No. 1. As explained above in relation to the dependency of claim 5, rather than broadening the scope of claims 4 and 1, claim 5 limits the scope of claim 4 by requiring that the hexose oxidase enzyme from a marine organism comprises either the amino acid sequences set out in SEQ. ID. No. 1 or a variant, homologue, derivative or fragment of that amino acid sequence having at least 75% homology with SEQ ID No. 1. Therefore the phrase objected to does not mean any carbohydrate oxidase from any biological source, but rather is limited to a hexose oxidase enzyme from a marine organism.

Also, claims 17 to 20 were rejected for allegedly being indefinite. Claims 17 to 20 have been deleted, rendering the rejection moot.

Finally, claims 4, 7, 10-15 and 29 were included in the rejections because they are dependent on rejected claims. As discussed above, none of claims 1-16 or 21-29 are indefinite. Accordingly, reconsideration and withdrawal of the rejection under 35 U.S.C. §112, second paragraph, is respectfully requested.

V. THE ART REJECTIONS ARE OVERCOME

Claims 1-16 and 21-29 were rejected under 35 U.S.C. §103 as allegedly unpatentable over European Patent 0 866 103 A1 (to Hamade *et al.*) in view of Hansen *et al.* (J. Biol. Chem. 272(17):11581-11587). Claims 1-16, 21, 23, 25 and 27 were also rejected under 35 U.S.C. §103 as allegedly unpatenatble over Hamade *et al.* (*supra*) in view of U.S. Patent 6,251,626 B1 (to Stougaard *et al.*). The rejections are respectfully traversed and will be addressed collectively.

Hamade et al. relates to a method for controlled release of compounds having antimicrobial activity and a coating composition capable of controlled release of compounds having antimicrobial activity. Specifically, the patent relates to a method for releasing a compound having antimicrobial activity from a matrix at a controlled rate, which comprises incorporating an enzyme and a substrate in the matrix beforehand to allow the enzyme and the substrate to react with each other in the matrix to thereby produce the compound having antimicrobial activity; and further relates to a coating composition comprising a film-forming resin, an enzyme, and a substrate, the enzyme said to be capable of reacting with the substrate to produce a compound having antimicrobial activity.

As admitted in the Office Action, Hamade *et al.* does not teach obtaining the enzyme from a marine organism.

Both Hansen *et al.* and Stougaard *et al.* relate to cloning the gene encoding the HOX enzyme from the marine algae *Chondrus crispus*. Neither relate to the anti-fouling composition of the present invention comprising a surface coating material; an enzyme obtained or obtainable from a marine organism; and a substrate for the enzyme; and/or a precursor enzyme and a precursor substrate, wherein the precursor enzyme and the precursor substrate are selected such that a substrate for the enzyme is generatable by action of the precursor enzyme on the precursor substrate; wherein the enzyme and the substrate are selected such that an anti-foulant compound is generatable by action of the enzyme on the substrate.

It is well-settled that there must be some prior art teaching which would have provided the necessary incentive or motivation for modifying the reference teachings. *In re Laskowski*, 12 U.S.P.Q. 2d 1397, 1399 (Fed. Cir. 1989); *In re Obukowitz*, 27 U.S.P.Q. 2d 1063 (BOPAI 1993). Further, "obvious to try" is not the standard under 35 U.S.C. §103. *In re Fine,* 5 U.S.P.Q. 2d 1596, 1599 (Fed. Cir. 1988). And, as stated by the Court in *In re Fritch*, 23 U.S.P.Q. 2d 1780, 1783-1784 (Fed. Cir. 1992): "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggests the desirability of the modification." Also, the Examiner is respectfully reminded that for the Section 103 rejection to be proper, **both the suggestion of the claimed invention and the expectation of success must be founded in the prior art, and not Applicants' disclosure**. *In re Dow*, 5 U.S.P.Q.2d 1529, 1531 (Fed. Cir. 1988).

Neither Hamade *et al.*, Hansen *et al.* or Stougaard *et al.* provide any incentive or motivation to combine the teachings and arrive at the present invention. Further, one of skill in the art would have no expectation of success in doing so.

Further, Applicants have identified that the use of an enzyme obtained or obtainable from a marine organism provides numerous surprising advantages over the prior art. These advantages include those listed on pages 5 and 6 of the description, namely.

- long-term effectiveness in environments;
- high affinity for glucose;
- reduced enzyme requirements;
- improved activity at operational temperatures;
- utilization of safe and readily available substrates;
- improved salt tolerance; and
- resistance to degradation by fouling organisms.

These advantages make the anti-fouling composition of the present invention particularly suitable for use in the marine environment, such as on the hull of a marine vessel. This novel and inventive feature, wherein use is made of an enzyme obtained or obtainable from a marine organism, is not disclosed in Hamade *et al.*, nor is it disclosed in Hansen *et al.*, or Stougaard *et al.*

The present Applicants were aware at the time the invention was made that hexose oxidase from *Chondrus crispus* was known, as acknowledged on page 6, line 5 of the

description. However, the fact that this enzyme was known does not render the present invention obvious. Hamade *et al.* provides no teaching that an enzyme obtained or obtainable from a marine organism would provide particular advantages in an anti-fouling composition. Hansen *et al.* and Stougaard *et al.* do not teach the use of hexose oxidase from *Chondrus crispus* in an anti-fouling composition, they simply teach that hexose oxidase from *Chondrus crispus* was known. Neither Hansen *et al.* nor Stougaard *et al.* would not provide the skilled person, who had Hamade *et al.* as a starting point, with any motivation to select, from the vast army of enzymes present in Hamade *et al.*, enzymes obtained or obtainable from a marine organism.

Accordingly, neither Hansen *et al.* nor Stougaard *et al.* remedy the deficiencies of Hamade *et al.* Therefore the rejections cannot stand; reconsideration and withdrawal of the rejections under 35 U.S.C. §103 is respectfully requested.

REQUEST FOR INTERVIEW

If any issue remains as an impediment to allowance, an interview with the Examiner is respectfully requested, prior to issuance of any paper other than a Notice of Allowance; and, the Examiner is respectfully requested to contact the undersigned to arrange a mutually convenient time and manner for such an interview.

CONCLUSION

In view of the amendment and remarks herewith, the application is in condition for allowance. Favorable reconsideration of the application and prompt issuance of a Notice of Allowance, or an interview at a very early date with a view to placing the application in condition for allowance, are earnestly solicited. The undersigned looks forward to hearing favorably from the Examiner at an early date.

Respectfully submitted,
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